Technical Report 1066

Discerning Critical Information: A Prairie Warrior '96 Case Study

David Simpson
Center for Army Leadership

Jon J. Fallesen
U.S. Army Research Institute

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Center for Army Leadership

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EDGAR M. JOHNSON
Director

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MAJ Steven M. Jones, Center for Army Leadership

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14. ABSTRACT *(Maximum 200 words)*: The increased attention to technologies for battle command has brought about an increased awareness of the importance of abilities and traits for leadership and tactical decision making. This study examined the relationship between conceptual capacity and the ability to discern critical information. Conceptual capacity was measured with a cognitive complexity method that used self-report and clinical judgment. Critical information discernment (CID) was measured by instructors and trained observers during a Command and General Staff Officer College exercise (Prairie Warrior '96). Self and peer ratings were also collected on leadership skills, personality and attitudes, CID performance, and experience. No relationship was found between the primary measure of the current level of conceptual capacity and CID; however, a Biodata cognitive complexity measure was negatively correlated to CID. About one-half of the variance in CID performance was explained by seven variables. Variables that contributed positively were analytic style, rank of position in the exercise, and whether performance was expected to apply to their next assignment. Negatively weighted factors were openness, object orientation, staying alert for unusual information, and feeling time pressured.

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David Simpson
Center for Army Leadership

Jon J. Fallesen
U.S. Army Research Institute

Fort Leavenworth Research Unit
Stanley M. Halpin, Chief

U.S. Army Research Institute for the Behavioral and Social Sciences
5001 Eisenhower Avenue, Alexandria, Virginia 22333-5600

Office, Deputy Chief of Staff for Personnel
Department of the Army

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FOREWORD

The Center for Army Leadership (CAL) and the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) joined together to identify what it takes to be a competent Army leader and battle commander. The conceptual skills of officers have been of particular interest. There has been remarklably little attention given to higher conceptual skills in Army instruction and personal development programs. Researchers from our two activities examined the relationship of conceptual capacity and battle command performance. The specific behavior that was investigated was the ability to discern critical information. Six sublevel behaviors, which were believed to contribute to critical information discernment, were identified by the research team. Fifty Command and General Staff Officer College students were rated by experienced observers during Prairie Warrior '96. These ratings were correlated with measures of conceptual capacity. It was hypothesized that individuals with higher conceptual capacity would display higher levels of critical information discernment.

The research underscored the value of ties between the ARI and the CAL. A combination of psychological tests of cognition and behavioral rating of performance provided useful insights into measuring conceputal capacity and critical information discernment. The findings, including the lack of some expected relationships, draw out the importance of verifying beliefs about factors and traits contributing to leadership performance. Subsequent research is continuing to examine additional individual differences in battle command performance. With a better understanding of the components of successful battle command, the Army will be better able to push forward with development and training plans for Force XXI and Army After Next leaders.

JOHN A. SPEARS
Colonel, Infantry
Director, Center for Army Leadership

ZITA M. SIMUTIS
Technical Director
Army Research Institute

EDGAR M. JOHNSON
Director
Army Research Institute

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DISCERNING CRITICAL INFORMATION: A PRAIRIE WARRIOR '96 CASE STUDY

EXECUTIVE SUMMARY

Research Requirement:

Can the U.S. Army identify a means of selecting or developing leaders who have the ability to discern critical information? Findings from previous Advanced Warfighter Experiments (AWE), Warfighter Exercises (WFX), and Combat Training Center (CTC) rotations indicated that leaders were not improving in their abilities to determine what information was relevant and how to properly package and disseminate that information to the appropriate level. A leader's discernment ability becomes increasingly important as the Army becomes smaller and its missions extend to nontraditional roles of operations other than war. While information technologies increase an organization's capacity for handling predictable information, the requirement for leaders to digest and act on more complex information and to handle unpredictable situations increases.

Emerging leadership doctrine identifies three categories of competencies: technical and tactical, interpersonal and communicative, and conceptual (Headquarters, DA, 1987). The Army has invested a significant amount of resources designing formal programs that develop the first two categories and virtually no time considering conceptual competencies, let alone focusing assessment or development on them (Kluever, Lynch, Matthies, Owens & Spears, 1992). The intent of this study is to begin to make up for this imbalance.

During the preparation of the experiment plan for Prairie Warrior 96 (PW96), it became apparent that although various information technologies would be tested in the exercise, there were no plans to study the conceptual capacities related to the technologies. The Battlefield Visualization Experiment in the PW96 AWE corrected this oversight. It provided an opportunity for researchers from the Center for Army Leadership (CAL), U.S.Army Research Institute for the Behavioral and Social Sciences (ARI) and Industrial College of the Armed Forces (ICAF) to test the relationship between cognitive complexity, stated in this report as conceptual capacity, and commander and staff performance in discerning critical information. This case study was developed to explore whether indicators of conceptual capacity are predictive of critical information discernment in the context of battlefield visualization.

Procedure:

The primary hypothesis of the study was that: Individuals with higher conceptual capacity would be better able to identify, synthesize, package, and disseminate critical information. A secondary purpose of the study was to explore the development of methods for the study of leadership traits and the human dimensions of battlefield visualization. Supporting objectives were to try out various measurement instruments and to gather psychometric data on them.

This case study was structured to assess current level of conceptual capacity and critical information discernment (CID) behaviors. Conceptual capacity level was measured before the exercise

using a modified version of the Career Path Appreciation (CPA) method and a Biodata instrument from ARI. Results were interpreted at ICAF and returned. Critical information discernment behaviors were assessed during PW96 by observation. Observers were provided a score sheet and used it to make daily observations. Additionally, critical information discernment behavior was assessed from peer and self ratings collected as supplemental items on an ARI 360 degree assessment instrument called Azimuth. The data sets for conceptual capacity level and critical information discernment behaviors were then compared to determine if a relationship existed. Interviews with selected participants were conducted to see if there were any distinguishing work or educational experiences among high and low performers.

Two groups of students from the Command and General Staff Officer Course (CGSOC) were earmarked for participation in this study. One group consisted of 41 officers from the Mobile Strike Force (MSF). Officers were earmarked for participation based on the key positions they held. The second group consisted of 27 students portraying commanders and staff officers of II Corps (Student Corps). The 68 made up the initial pool of individuals who agreed to fill out various survey instruments and to be observed during PW96.

Findings:

There was no direct relationship between the modified CPA (MCPA) measure of Conceptual Capacity Level and ranking of CID performance ($r = -.07$) (see Figure 1). There were moderate negative correlations between CID performance and Cognitive Complexity ($r = -.25$, $p = .09$) and Openness scales ($r = -.28$, $p = .05$) from a Biodata test. The relationship between Critical Information Discernment and Openness were stronger (negatively) when differences in jobs, difficulty, experience, and time pressure were accounted for ($r = -.43$).

There were high correlations whenever measures were based on self-report instruments (MCPA, Biodata, Azimuth). An individual's bias in response was consistent across self-report instruments. Experienced observer's ratings of performance did not correspond to participant's ratings of performance. Additionally, neither of these corresponded to peers' ratings of performance. The findings suggest one or more of the following: (1) it is difficult to rely on individuals to reliably and validly rate themselves; (2) it is difficult to test for conceptual capacity; and (3) it is difficult to observe CID skill. A trend was noticed from the Critical Information discernment score sheets that indicated high information discerners were more willing to risk making mistakes and more confident in their assessments/predictions than those that made fewer assessments/predictions.

Additional examination of the psychometric parameters of the Conceptual Capacity Level variable seems to be in order. A previous study (Lewis, 1993) showed modest levels of construct validity (.42 to .46) for the CPA approach for measuring Conceptual Capacity Level. Although these validity levels are somewhat supportive, they are not overwhelming evidence that Conceptual Capacity Level is a dependable predictor at present. The CPA was modified for this study to focus on the Phrases portion, which allows the individual to make choices about phrases that describe his or her style of working. Nonstandard interpretation of the phrases by students and responses affected by social desirability certainly seem possible. Other measurement methods should be identified (or developed) and tried. There should be more emphasis on requiring the individual to demonstrate abilities as opposed to attempt to describe processes about which he or she may not be familiar.

Measuring information discernment performance by observation was difficult. As far as we know, this was the first time that CID behaviors had been measured in this way. As a result, normative or

doctrinal standards did not exist for comparison. Another limitation was that observers could have differed in how they decided to give a rating to a student they were observing. These differences were accounted for through observer training and by having members of the research team observe both the students and the observers in the performance of their duties. We found the narrative explanation on the score sheet consistently provided the most insight into a student's information discernment performance. The narrative was the primary source of information used by a panel to rank order the students' CID performance.

The score sheet enabled researchers to discriminate among students' information discernment behaviors and did not impose an excessive workload on the observers. It has potential for application during scheduled WFXs and CTC rotations.

From this study we learned additionally the importance of measuring knowledge, experience, and motivation. A very plausible hypothesis—but untestable with the current data—is that experience or knowledge had a considerable influence on performance. Differences in experience could have overshadowed other differences or effects of the hypothesized relationship with cognitive complexity. It seems, based on limited data, that low student motivation did not mask a relationship between performance and Conceptual Capacity Level. We observed instances of low participation, but the effect was not universal. Motivated and challenged students tended to perform better, but were not necessarily higher scorers on cognitive complexity. Motivation and experience should be more completely measured in future studies in this area.

Utilization of Findings:

The findings in this study highlight the complexity involved in understanding the cognitive aspects of human behavior and the intricate relationships among the factors. The findings emphasize the need for increased effort to understand and define the conceptual skills that are desired in Army leaders. Measuring conceptual capacity in a way that requires individuals to demonstrate their ability provides a possible focus for future research and training development efforts. Follow-up studies are essential to address these additional aspects of the human dimension of Battlefield Visualization and to assist in the design of strategies that address the development of conceptual competencies. The best possible outcome from this study would be that it energizes multiple efforts for improved leader development programs.

CONTENTS

DISCERNING CRITICAL INFORMATION: A PRAIRIE WARRIOR '96 CASE STUDY

Introduction

The Problem

Can the US Army identify a means of selecting or developing leaders who have the ability to discern critical information? Findings from previous Advanced Warfighter Experiments (AWE), Warfighter Exercises (WFX), and Combat Training Center (CTC) rotations indicated that leaders were not improving in their abilities to determine what information was relevant and how to properly package and disseminate that information to the appropriate level. A leader's discernment ability becomes increasingly important as the Army becomes smaller and its missions extend to nontraditional roles of operations other than war. While information technologies increase an organization's capacity for handling predictable information, the requirement for leaders to digest and act on more complex information and to handle unpredictable situations increases.

Background

Emerging leadership doctrine identifies three categories of competencies: technical and tactical, interpersonal and communicative, and conceptual (Headquarters, DA, 1987). The Army has invested a significant amount of resources designing formal programs which develop the first two categories and virtually no time considering conceptual competencies, let alone focusing assessment or development on them (Kluever, Lynch, Matthies, Owens & Spears, 1992). The intent of this study is to begin to make up for this imbalance.

During the preparation of the experiment plan for Prairie Warrior 96 (PW96), it became apparent that although various information technologies would be tested in the Mobile Strike Force (MSF) [1] no study of the conceptual capacities related to the technologies would be addressed.

One of the MSF initiatives this year was the use of a Combat Information Center (CIC) to produce "a single, synthesized picture of friendly and enemy forces, and the battlespace environment" called the relevant common picture (RCP) (p. 3-20, EER Systems, 1996). The CIC was to serve as a centralized collection point for battlefield intelligence from across functional areas and to integrate the information into a meaningful situation picture for the Commander and others. This MSF initiative was seen as an excellent opportunity to study how individuals who receive critical information understand and integrate that information. Not everyone in a command post recognizes the criticality of information or interprets it in the same way. The competency that was thought to be key to the operation of the CIC was critical information discernment, a key component in battlefield visualization.

People differ in many ways in how they discern information. Some individuals understand information in a very concrete way, considering only the meaning at the surface. Others go beyond the apparent meaning and make second and third order interpretations and associations with what else they know (Fredericksen, 1986; Holyoak & Nisbett, 1988; Soloway, Adelson & Ehrlich, 1988). People also differ in preference for detail or for general information (Michel & Riedel, 1988). Some people operate at

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[1] The MSF is a notional division used during Prairie Warrior exercises to explore and develop doctrine and capabilities for future forces.

a theoretical level while others operate at an experiential and applied level (Kolb, 1984). Besides differing among these characteristics, each individual is likely to adapt his or her problem solving approach to the situation (Klein, Orasanu, Calderwood, & Zsambok, 1993; Payne, Bettman & Johnson, 1993).

One relevant approach that tries to account for individual differences is cognitive complexity. Cognitive complexity [2] involves consistent tendencies of individuals to process information in certain ways. A simplistic view of cognitive complexity is the extent of the breadth and depth in the way a person thinks. The concept of cognitive complexity is marked by two cognitive processes: differentiation and integration. Differentiation is the ability to discern multiple dimensions or differences, and integration is the ability to comprehend multiple concepts and put them together in a meaningful way. Sometimes cognitive complexity is discussed as work capacity. The longer the time span that one sees and plans for, the higher one's work capacity (Hooijberg & Quinn, 1992). The theory implies that an individual with higher cognitive complexity can understand complex situations and is better able to make good decisions in uncertain situations.

Jacques (1976) used the notion of cognitive complexity in his stratified systems theory (SST). SST proposes that the higher the level of an organization, the more complex the tasks and functions. As functions increase in complexity so must the responsible leaders capability for complexity increase. SST specifies that the number of levels will not exceed seven for any organization. Jacques (1989) has determined various parameters for the different "strata" of organizations and Jacobs and Jacques (1987) have specified the associated personnel requirements. Time span is one way to measure complexity of work. Time span is the maximum allowed completion time of the longest tasks or programs for which an individual is held accountable.

One approach to measure an individual's potential for complex work is Career Path Appreciation (CPA) (Stamp, 1986). CPA has had some success predicting managerial performance (Stamp, 1988) in prior research. Although this was not directly related to leadership, it did provide insights into the difficulty of predicting leadership potential. A predictive capability for Army leaders would have merit because leadership potential could be identified early, and officer assignments could be optimized to further develop or to take advantage of the identified capabilities. Although desirable, the ability to predict leadership reliably is probably many years into the future. An ability to predict high performing leaders also would imply that an individual's level of complexity at any point in their careers could be determined. If cognitive capacity can be reliably measured, then we can see if capacity is a stable characteristic or whether it might be increased through training (e.g. Streufert & Swezey, 1986).

PW96 provided an opportunity to test the relationship between cognitive complexity, stated in this report as conceptual capacity, and commander and staff performance in discerning critical information. This case study was developed to explore whether indicators of conceptual capacity are predictive of critical information discernment in the context of battlefield visualization.

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[2] There is not room in this report to give complete background on cognitive complexity and its relationship to other variables. For excellent reviews refer to McDaniel & Lawrence, 1990; Streufert & Swezey, 1986; and Streufert & Streufert, 1978. For proposed relationships to leadership refer to Jacobs & Jacques, 1987; Jacques & Clement, 1991; Phillips & Hunt, 1992.

Method

Hypothesis

The primary hypothesis of the study was that: Individuals with higher conceptual capacity would be better able to identify, synthesize, package and disseminate critical information. A secondary purpose of the study was to explore the development of methods for the study of leadership traits and the human dimensions of battlefield visualization. Supporting objectives were to try out various measurement instruments and to gather psychometric data on them.

Case Study Structure

This case study was structured to assess current level of conceptual capacity and critical information discernment behaviors. Conceptual capacity level was measured before the exercise using a modified version of the CPA method and a Biodata instrument from ARI. CPA results were interpreted at the Industrial College of the Armed Forces (ICAF) and returned. Critical information discernment behaviors were assessed during PW96 by observation. Observers were provided a score sheet (see Appendix A) and used it to make daily observations. Additionally, critical information discernment behavior was assessed from peer and self ratings collected as supplemental items on an ARI 360 degree assessment instrument called Azimuth. The data sets for conceptual capacity level and critical information discernment behaviors were then compared to determine if a relationship existed. Interviews with selected participants were conducted to see if there were any distinguishing work or educational experiences among high and low performers.

Participants

Two groups of students from the Command and General Staff Officer Course (CGSOC) were earmarked for participation in this study. One group consisted of 41 officers from the MSF. Officers were earmarked for participation based on the key positions they held. The second group consisted of 27 students portraying commanders and staff officers of II Corps (Student Corps). Different numbers of participants were available for the various surveys and observation during PW96. (See Appendix B for the number of MSF and II Corps participants for each set of measurement instruments).

Assessment Instruments

Modified CPA. The CPA method consists of three parts: symbols[3], work history[4], and phrases (Lewis, 1993; Stamp, 1986). In the phrases portion, an interviewee receives nine sets of six cards with phrases about a style of working or thinking. The interviewee selects the phrase which is most like how he or she works and the phrase which is the least preferred way to approach work. The interviewee also

[3] The symbols task involves the Bruner concept formation task in which the interviewee is to discover a rule by which a set of symbols depicted on cards is sorted according to four example "targets" (Bruner, 1966).

[4] The work history involves surveying the interviewee's major work assignments and their challenge, time span, and time horizon.

elaborates on the choices. The phrases are ordered from less complex to more complex. The average score of most preferred selections was used as a starting indicator of current conceptual capacity level, to which, clinical judgment of semantic content was applied, with an eye on total inversions (number of instances where the least preferred phrase was higher than the most preferred phrase). The CPA results in a score of current work capacity and, with the interviewee's age, a score of predicted future work capacity or "mode" (Lewis, 1993).

For this study, the phrases portion of the CPA was administered to 41 students from the MSF and 27 students from II Corps. Materials from two of the MSF students and one of the II Corps students were not scorable. There were two scorers from ICAF who assigned current work capacity or Conceptual Capacity Level (CL), which was the primary predictor in this study. Scoring requires clinical judgment applied by trained interviewees. The Conceptual Capacity Level measure was the midpoint of the two scores. The scorers used the following in their judgments: the sum of point values of all "preferred" phrases, the number of times a less complex phrase was preferred over a more complex one, the average number of lines written to explain the nine sets of "most" and "least" choices, and the content of the interviewees explanation.

In a previous study (Lewis, 1993), the CPA had an inter-rater reliability of .81 . The CPA also had a correlation of .46 with two Army War College (AWC) instructors' ratings of the students' potential to become general officers. Initial characteristics of the modified CPA were available from a separate sample of ICAF students (McGee, Jacobs, Kilcullen & Barber, 1996). The correlation between the modified CPA and the CPA was .68. On the average, the modified CPA was about 1.5 points lower than the CPA. The difference tended to be greater at higher levels of current level of conceptual capacity. The inter-rater reliability was .95 for two raters. The inter-rater reliability for our CGSOC sample in this study was .88.

Biodata. Biodata is a scale developed by ARI. The instrument consists of 87 questions that generally ask how often or to what extent an individual can be described in a certain way. The test results in scores on eight scales: achievement motivation, openness to new ideas, dominance, peer leadership, cognitive complexity, need for personal approval from others, orientation towards others as objects (a depersonalizing orientation), and a lie scale. Biodata refers to biographical information that describes an individual's past experiences. Typical biodata tests use instances that can be easily and objectively reported, (e.g., How many books do you read a month? What is this individual's grade point average?) From these objective accounts, inferences can be made about an individual. The data are not necessarily obtained only from self-reports but from existing records or other people. Instead of relying on specific instances, the ARI-developed Biodata scales included self-reports of a more general nature. (For example to the question "How often have you been recognized for unusually effective work performance?" the response choices were "very often," "often," "sometimes," "seldom," and "never.") Biodata was taken from 40 MSF and 27 II Corps officers.

Azimuth. Azimuth is an instrument which intends to aid self-development of leadership skills. Items reflecting important qualities of leadership are completed by the person on him or herself and on peers. Feedback is provided based on a comparison of individuals' self-perceptions and one's peer's perceptions of them. Items belong to one of 12 elements generally corresponding to doctrinal leadership competencies (Headquarters, 1990).

The twelve elements calculated from Azimuth items are described as follows.

Supervisory Skills. This broad category of leader behavior is broken out into the following three elements:

> Interpersonal focus: This element examines the way in which a leader interacts with subordinates. It is concerned with both interpersonal behavior and empowerment of subordinates to make decisions and grow.
>
> Team focus: This element looks at leadership in developing, motivating, and resourcing teams. It is concerned with ability to select and challenge a high performing team.
>
> Mission Focus: Mission focus looks at the leadership provided to create a supportive environment in which subordinates can accomplish their mission.

Tactical and Technical Competence. Tactical and technical competence is also broken down into three specific elements:

> Problem solving skills: This element looks at the leader as a decision maker and the ability to "get to the heart of the matter" and to sort out the important from the unimportant details.
>
> Knowledge: The knowledge element looks at the degree to which the leader is an accomplished professional in a technical or tactical area of expertise.
>
> Planning/Organizational skills: The planning and organizational skills element addresses whether the leader can meet deadlines, can maintain focus on primary issues even when other things compete for attention, and can see the "big picture".

Political Skills. This element is concerned with sensitivity to political issues and interests beyond the purely military. This element includes economic and societal interests, and the ability to maintain good relationships with outside interest groups, as well as peers and superiors.

Ethics. This element is concerned with the leader's personal and professional standard of conduct, and includes a willingness to be accountable for personal failures and to set the proper example of high standards of interpersonal responsibility and honesty.

Communication/Influence. Leadership requires the ability to establish and maintain effective two-way communication with others, including peers, subordinates and superiors. This includes the establishment and maintenance of both formal and informal channels of communication and information dissemination, as well as the ability to listen effectively and provide an atmosphere conducive to openness and honesty.

Social Maturity. This element is concerned with the ability to maintain composure under conditions which may be personally threatening, the ability to admit and learn from your mistakes, and willingness to consider the opinions of others which may differ from the leader's own opinions.

Self-Centeredness. This is a negative element in that the questions which define it concern behaviors to be avoided. These behaviors indicate poor leadership. This element is centered around the focus on self and lack of concern and care for others. This element describes an individual who is arrogant, vindictive, impressed with self, and has an explosive temper.

Compulsive Behavior. Like the element above, this element is concerned with behaviors which may be indicators of poor leadership. This element examines the tendency to micromanage, to work self and others to excess, be intolerant of ambiguity, and to desire excessive information before making decisions.

Additional Items Relating to Prairie Warrior. Twenty-two supplemental questions were added to the current set of 98 Azimuth items. Six of these mirrored 6 of the 7 critical information discernment behaviors that were rated by observers in the exercise. Other questions dealt with problem solving and reasoning behaviors, general problem solving styles, use and knowledge of systems, and confidence and generalizability of the ratings.

Spearman Brown reliability coefficients were computed on peer ratings from a sample of 545 CAS3 students. Reliability coefficients ranged from .69 to .78 for all but the compulsive behavior element, which was .48.

Administration of Azimuth. Azimuth was administered to 66 students who rated themselves and peers. Students were assigned to rate two or three peers. The assignments were designed to include a student who was in the same cell as the ratee, one student who may have principally provided information to the ratee, and one student who may have received information products from the ratee. Subordinate commanders were rated by a commander, deputy commander, chief of staff, or operations officer. Once these criteria were met, raters were selected who had branch commonality with the students they were to rate. For 15 students one of their ratings came from 11 senior noncommissioned officers from the US Army Sergeants Major Academywho were also participating in the PW96 exercise. Ratings of a student were combined into a category of ratings from peers, regardless of whether the raters were playing the role of a superior, subordinate, or peer.

Critical Information Discernment

Critical Information Discernment Behaviors. One of the requirements faced in this study was to define critical information discernment so that it could be measured. Three different categories were defined to differentiate among behaviors (see Table 1). The general categories were: information handling, information usage, and integration.

Information handling consisted of three subcategories: Commander's critical information requirements (CCIR), filtering information, and seeking information.

CCIR is a formalization of information handling in which the staff identifies, plans, collects, and manages critical information elements. There is no standard set of information elements that are universally applicable, so doctrine establishes a formal policy for the processing of CCIR. The CCIR process may be an overspecialization, because the process is not always followed closely. Often CCIR are considered prior to a mission or exercise and not kept current or updated. Once a mission or exercise starts, attention is directed at specific information and less on

Table 1.
Critical Information Discernment behaviors.

Category	Behavior
Information handling	Management and attention to formal CCIR.
	Filtering of information.
	Information sought out proactively.
Use of information	Specific predictions of battlefield situations.
	Kept track of minor--but potentially critical situations--as they developed.
	Identified or anticipated major changes in enemy or friendly intentions, schedules, resources, and boundaries.
Integration	Integrated information to produce critical insights.

the management of the information. There is a danger of an exclusive focus on one or the other tendency. If a staff or an individual focuses on the process of information management, they may not understand as well as they should the meaning of the information, or if they focus on what specific information means they may lose sight of other information or sources that are available and important.

Information handling also involves the active search for information. If information is not actively sought out, the staff will not have the best and latest information with which to work. New--and especially unexpected information--undoubtedly suggests other possibilities of what is happening on the battlefield. These other possibilities are cues to be confirmed or disconfirmed through additional information search. Confirming and clarifying the situation should be a continual process.

Filtering of information is an important part of information handling. Whether information has been received without request or has been actively sought, the sheer magnitude requires that it be reduced to that which is most important and most time-critical. The most critical is not always that which is most immediate--has the most sudden implications. If the staff focuses too greatly on routine handling of all information, the less important information will bog down processing and lead to the lack of clarity in battlefield visualization.

Information usage was separated into three categories. The categories were defined to be general enough to include battlefield visualization and decision making, regardless of echelon or functional area. The subcategories are: prediction, tracking of minor situations, and identification of major changes.

Information is used to serve as a basis for prediction. Predictions of battlefield situations and outcomes are important for preparing for future operations. Predictions should be based on the best information available.

Tracking minor situations is an important task that also is based on information received. Since dynamic battlefield situations are full of uncertainty and intentional deception, what might

seem to be a minor and trivial event might actually be the only warning of a significant enemy action or a friendly difficulty to perform. What might appear to be the sign or cue of one event might actually be indicating something quite different. Interpretations that keep multiple possibilities open is one way of dealing with battlefield uncertainty.

Anticipation or identification of major changes in plans or operations is another key task of Critical Information discernment. Changes can occur about intentions, schedules, resources, and boundaries. No operation goes completely as planned or can be entirely envisioned. The more successful commander will have a clear understanding of the current situation, friendly plan, enemy capabilities, and some idea about the future.

Observers. Observers came from five different organizations. All had work-related experience in the study and observation of command and staff behavior. Fifteen of the observers came from either of two Battle Command Training Program teams. These observers' day-to-day jobs require that they watch units performing battle staff exercises and provide training feedback to them. Twelve other observers were instructors from the Center for Army Tactics, where they instruct CGSOC students and observe performance in classroom exercises. The other five observers came from ARI, CAL, and the TRADOC Analysis Center (TRAC). These observers had extensive experience observing command and staff exercises during BCTP Warfighter Exercises, CTC rotations, and in the classroom.

Ratings of Behaviors. A Critical Information discernment rating score sheet was used by the observers to provide ratings and explanations of events that they observed (see Appendix A). An earlier version of the score sheet was tried out during a previous simulation exercise for the MSF students. Several of the observers participated and provided feedback on the sheets and rating procedures.

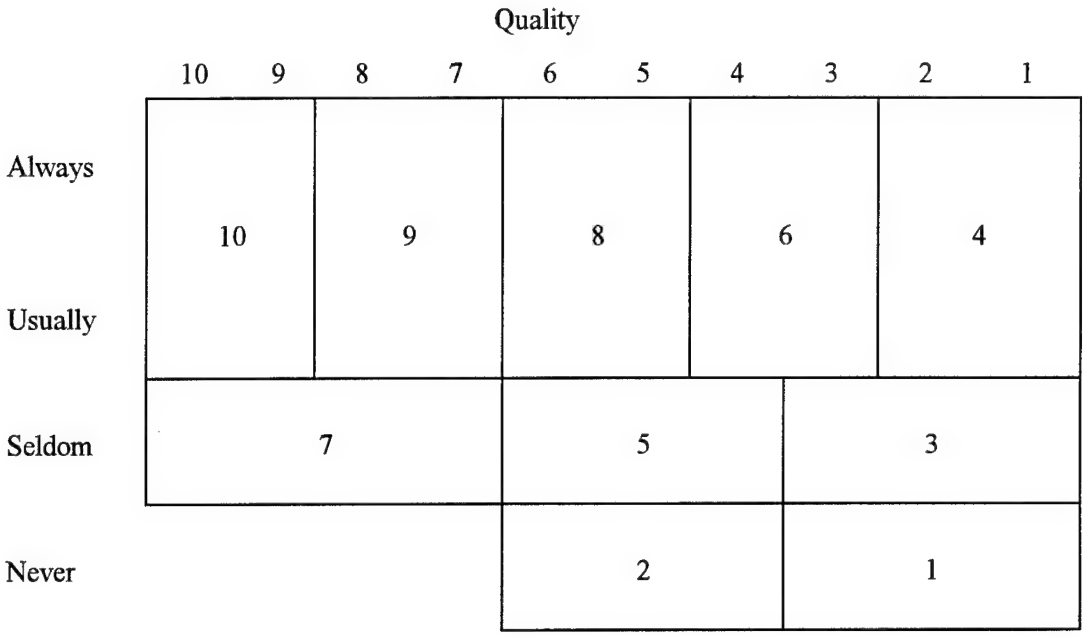
During PW96, observers were asked to rate each student they observed daily using the score sheet. Frequency ratings were to show when the Critical Information discernment behaviors were not warranted; observers were instructed to rate only those behaviors observed.

Observers were also prompted to remark about extenuating circumstances for the behaviors. They were asked to comment about whether the student was performing at or below potential, whether the student was constrained by position or command relationship, whether the realism or quality of information was suspect, and how much of a challenge the opposing force was.

Processing of Ratings. The frequency and quality ratings given by observers were combined into a single rating for each Critical Information discernment behavior. Table 2 shows how the separate ratings were combined into a single rating. For example, if a student received a frequency rating of Usually and a quality rating of 8, a combined rating from the look-up table would have been a 9. The quality and combined ratings correlated at .90 suggesting that the combination and frequency did not affect the results.

Panel Ratings. Three of the experimenters reviewed the observation sheets independent of one another and made an initial recommendation to categorize the reported behaviors and ratings according to low, medium, or high performance categories. There were 33 matches in assignment and 17 mismatches. Mismatches were no further apart than a neighboring category. The panel then met for four hours to discuss the assignments and to resolve any differences. Panel members resolved differences by judging the quality of explanations or from observations that one of the members had made to confirm or disconfirm an observer's rating. A fourth CID category of medium-high was added to more accurately differentiate among students' behaviors.

Table 2.
Combination of Frequency and Quality Ratings of Information Discernment



Two of the panel members independently ranked the students in the high and medium high categories and again met to resolve discrepancies. Since one of the prime reasons for low categorizations was the absence of explanations on CID instances, there was little qualitative interpretation that could be done in the two lowest categories. For the low and medium categories the average combined rating for behaviors 4, 5 and 7 was used to rank order these students with behaviors 1, 2 and 3 breaking ties.

Results

Overview

There was no direct relationship between the modified CPA (MCPA) measure of Conceptual Capacity Level and ranking of CID performance (r= -.07) (see Figure 1). There were moderate negative correlations between CID performance and the Biodata's Cognitive Complexity (r= -.25, p= .09) and Openness scales (r= -.28, p= .05).

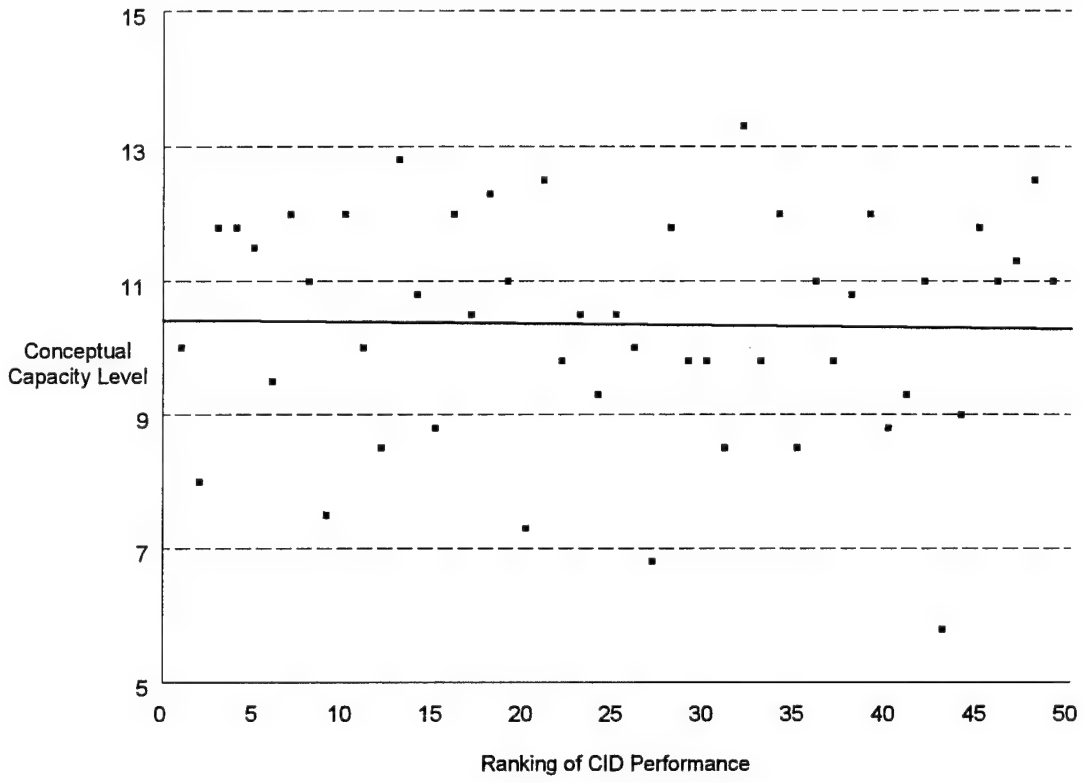


Figure 1. Critical information discernment and conceptual capacity level (r= -.07).

Critical Information Discernment

Quantity of ratings. The number of ratings differed among the seven behaviors and among students being rated. For the seven behaviors, the fewest number of ratings was 178 and the most was 227 (aggregating across the seven days of the exercise and across individuals). About 40 percent of the students' behavior was based on ratings from six to eight days of observation. Another 36 percent was based on four or five days, and the remaining 24 percent were based on one, two, or three days of observation.

Explanations of ratings. A sample of seven of the 32 observers' ratings was examined to understand (1) whether direct or indirect relationships to the behavior were made by the raters and (2) whether specific or general support was given in their explanations. These issues relate to the adequacy of measurement methods, the quality of raters, and the behaviors displayed by the students as determined by a subsample of 17 students. Over 97 percent of the explanations were judged to be supportive of the

specific behavior being rated. Over 70 percent of the explanations for prediction, tracking, and identifying major changes, referred to specific instances dealing with tactics and about one fifth dealt with more general behavior. For the integration behavior, about two fifths of the observations cited specific instances and three fifths cited general tendencies.

Over 70 percent of the explanations on tracking minor issues had direct relationships to the behavior. Explanations on identification of major changes, had a reverse trend. Seventy-two percent were indirectly related. (An indirect explanation suggests that the observer was considering multiple instances of the behavior or interpreting the item more broadly than the method intended.) Explanations for integration and prediction showed about 35 percent of the relationships to be directly related to these two behavior categories.

Type of job. A multiple regression between type of job and performance showed no significant relationship (r^2= .09, $F_{(3,46)}$= 1.44). Types of jobs considered included command, operations, intelligence, and service support. This finding implies that students did not perform differently at Critical Information discernment across the different command and staff positions.

Motivation. Estimates of student motivation were made on 25 students. These estimates were made from the interpretation of an observer's comments about the student's performance potential and morale, independent of the CID performance ratings. A significant correlation was found between discernment ranking and motivation (r= .487, p= .01). There was a near-zero correlation between discernment and Conceptual Capacity Level when motivation was partialled out ($r_{c,cl.m}$= .07).

Time pressure. An estimate of the amount of challenge that the students were under came from item 115 on the Azimuth instrument. When the students' ratings of time pressure were removed, the correlation between discernment and Conceptual Capacity Level was still near-zero ($r_{c,cl.t}$= .01).

Organizational differences. The Student Corps performed better than the MSF Division as determined by comparison of the distribution of scores across the five performance categories ($F_{1,48} = 4.55$, $p<.05$)

Conceptual Capacity

There was no significant difference in the distribution of Conceptual Capacity Level scores for this sample of 65 CGSOC students and those of higher rank from the earlier Army War College (AWC) sample (Lewis, 1993) (see Figure 2) (χ^2_{15}= 13.07, p= .60).

Biodata correlations with Critical Information Discernment. The Biodata scales did not have very large correlations with the performance criterion. Only the Openness scale had a significant negative correlation with ranking of Critical Information discernment (see Table 3).

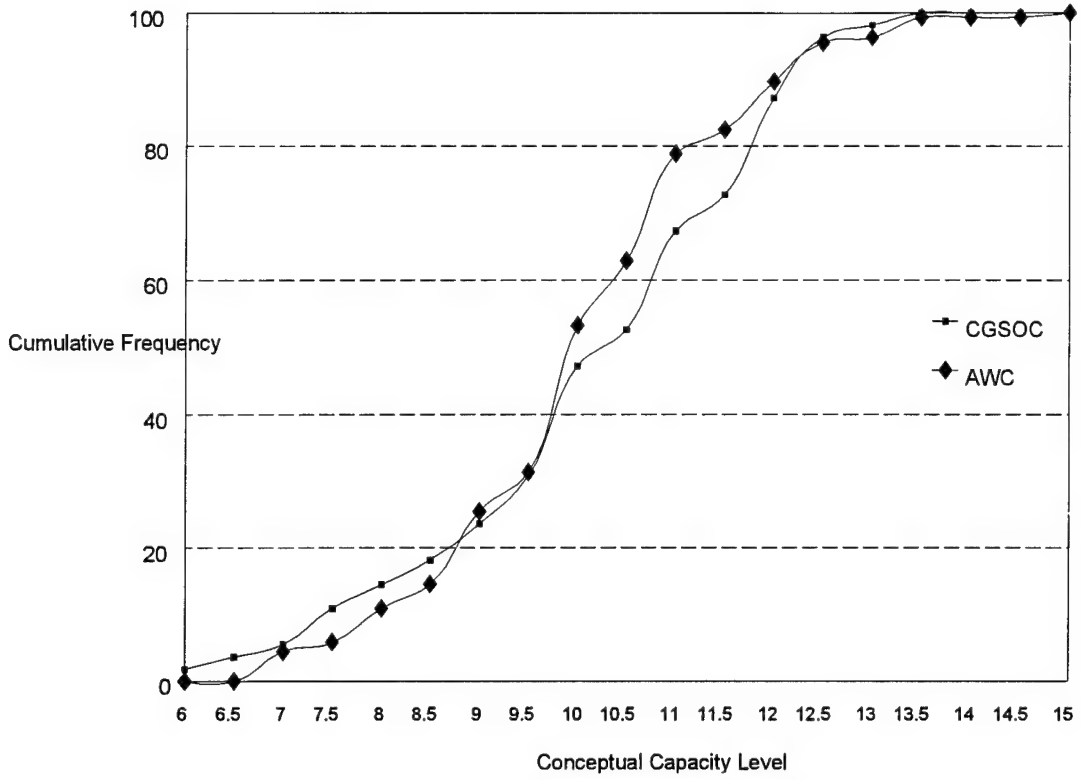


Figure 2. Cumulative distribution of conceptual capacity level for CGSOC and AWC

Table 3. Correlations and Observed Significance Levels between CID Ranking and Biodata Scales (n=49, correlation in **bold**, significance level below)

	Achievment	Openness	Dominance	Peer Leadership	Cognitive Complexity	Need for Approval	Object Orientation	Lie
Ranking of	**.15**	**-.28**	**.07**	**-.13**	**-.25**	**.16**	**.25**	**-.01**
CID	.30	.05	.63	.36	.09	.27	.09	.96

Additional survey questions. After an initial look at the results and the lack of a relationship between Conceptual Capacity Level and performance, available students were surveyed. They were asked four additional questions dealing with their perceptions about the challenges of the exercise. The intent of these questions were to address whether the load of the exercise was so low that any relationship was masked. Responses were received from 28 of the MSF students and 17 of the II Corps students.

The four items were:

1. Rate the degree of task difficulty you expected during PW96. (7 very difficult to 1 not difficult)
2. Rate the degree of task difficulty you experienced during PW96.
3. If there was a difference in what you expected and what you experienced, explain why.
4. To what degree of similarity was the job you performed in PW96 compared to what you have done in the past? (7 great deal of similarity to 1 no similarity)

Difficulty. Thirty-six (80%) of the students reported that experienced difficulty was medium or higher. Twenty (44.4%) of the student's experienced difficulty matched what they expected. Eighteen (40%) of the student's experienced difficulty was lower than they expected, and seven (15.6%) had experienced difficulty that was higher than expected.

Twenty-five students provided an explanation for their change in assessment of difficulty. Some (18 of 25) found difficulty to be less than expected. Seven of 18 discussed this as a positive change and 11 felt negatively about the change (see Tables 4 and 5). Five of the 25 students providing an explanation reported that their job was not challenging.

Table 4.
Change from expected to experienced difficulty and interpretation of change.

Change in Difficulty	Pleased	Displeased	Totals
Lower than expected	7	11	18
Higher than expected	3	4	7
Totals	10	15	25

Table 5.
Reasons for changes in perception of difficulty.

Student Explanations for Change in Perception	Frequency
Positive	
Fellow students were better than anticipated.	2
The job requirements became clearer and work was more satisfying.	2
Own anxiety was not as high as expected.	2
The units' plans worked out better than expected.	2
The simulation supported learning better than expected.	1
Expected that working at a higher echelon would be more difficult.	1
Negative	
Job was not challenging.	5
Systems (e.g., logistics, aviation, intelligence) were not played adequately.	5
Fellow students were not as involved as they ought to have been.	2
Doctrine and tactics were more difficult than expected.	1
Expectations on students from outside the units increased.	1
Trainers caused distractions.	1

There was a positive relationship between difficulty and performance; the higher that experienced difficulty was rated the better Critical Information discernment was ($r_{diff,cr}$= .38, p= .03). Experienced difficulty had no significant correlation with Conceptual Capacity Level or the Biodata Openness or Cognitive Complexity scores. Partialling out experience did not noticeably increase the relationship between Conceptual Capacity Level and Critical Information discernment ($r_{CID,CL.exp}$ = .02, p = .93).

Similarity. Forty-two of the students rated similarity of their PW96 job to what they had done in the past. The average rating was 4.1. Rated similarity did not correlate with Critical Information discernment ($r_{sim,cr}$= -.03), Conceptual Capacity Level ($r_{sim,cl}$= .16), or Cognitive Complexity ($r_{sim,cc}$= .17). Rated similarity had a positive correlation with the Biodata Openness score ($r_{sim,op}$= .398, p=.009). This relationship suggests that those rating similarity higher were more open to seeing an application of their previous experience. There was no correlation between Conceptual Capacity Level and Critical Information discernment when similarity was partialled out. The negative correlation between Openness and Critical Information discernment increased in magnitude when similarity was partialled out ($r_{op,cr.sim}$= -.37, p=.05).

Challenge of the Task. The magnitude of the negative correlation between Openness and Critical Information discernment increased when the effects of several task complexity variables were simultaneously partialled out. These task complexity variables were:

The rank of the position of a student's job.
Experienced difficulty.
Expected difficulty.
Similarity of experience to their job.
Self-assessment of the time pressure they were under.

The partial correlation between Openness and Critical Information discernment was negative ($r_{CID,Open.Chall}$ = -.43, p= .03). The partial correlation between Conceptual Capacity Level and Critical Information discernment was still near zero ($r_{CID,CL.Chall}$ = -.039).

Students did not indicate a lack of interest or challenge (80% of them reported experienced difficulty equal to or greater than the midpoint of the seven point scale and only 10 percent attributed displeasure to lack of a challenging job). Nor did they indicate that their jobs in this exercise were very similar to their experience (half of them rated similarity at the midpoint or higher). However, if task complexity was controlled for, the relationship between Openness and Critical Information discernment became stronger in the negative direction.

Biodata Correlations with Current Level. While the largest correlation of note so far showed a negative relationship between Openness and Critical Information discernment rank, there were significant correlations between Current Level of Conceptual Capacity and four of the Biodata scales. (see Table 6). Openness and Cognitive Complexity had the largest correlations with Conceptual Capacity Level, while Dominance and Need for Personal Approval from Others had more modest correlations with Conceptual Capacity Level. The three other scales did not have significant correlations with Conceptual Capacity Level.

Table 6. Correlations and Observed Significance Levels between Current Level of Conceptual Capacity and Biodata Scales (n=50, correlation in **bold**, significance level below)

	Achievment	Openness	Dominance	Peer Leadership	Cognitive Complexity	Need for Approval	Object Orientation	Lie
Current	**.18**	**.50**	**.35**	**.17**	**.44**	**.29**	**.14**	**-.12**
Level	.23	.0003	.01	.25	.002	.05	.35	.40

Azimuth Results

Azimuth Correlations with Performance. Azimuth provides an alternate set of predictors for the performance measure of Critical Information discernment and the performance measure provides an independent criterion for gauging Azimuth results. There were no significant correlations between performance and elements rated by peers (correlations ranged from $\mathbf{r}_{cr,EL7} = -.16$ to $\mathbf{r}_{cr,EL12} = .12$). There were no significant correlations between performance and self-rated elements (correlations ranged from $\mathbf{r}_{cr,ELS7} = -.27$ to $\mathbf{r}_{cr,ELS10} = -.09$) (see Table 7).

Table 7. Pearson product-moment correlations between ranking of Critical Information Discernment and Azimuth element ratings (sample size = 49 to 50).

Azimuth Elements	Self ratings	Peer ratings
Interpersonal focus	-.21	-.02
Team focus	-.20	-.03
Mission focus	-.14	-.09
Problem solving skills	-.21	.01
Knowledge	-.14	.03
Planning/organizational skills	-.11	-.04
Political skills	-.27	-.16
Ethics	-.19	.00
Communication/influence	-.12	-.02
Social maturity	-.10	-.05
Self-centeredness	-.22	-.02
Compulsive behavior	-.22	.12

Only five of the individual self-rated items correlated significantly with the performance criterion (see Table 8). These all had negative correlations, indicating that the students ranking high on performance thought these items were not as descriptive of themselves compared to the students who performed poorly.

Table 8.
Azimuth items correlating with CID (* < .05, ** < .01)

Azimuth Item	Correlation with CID
60. [Does not] micromanage.	-.37 **
71. Seeks knowledge about world political and economic conditions.	-.40 **
76. Shows interest in the professional growth of subordinates.	-.35 **
94. Uses praise to accomplish the organization's objectives.	-.31 *
98. [Does not] want it done "my way" or no way.	-.33 *

Besides those 5 items mentioned above, several of the self-rated items had significant negative correlations with the individual discernment behaviors rated by observers (see Table 9).

Table 9.
Self-rated items correlating negatively with one or more of the information discernment behaviors.

Azimuth Item	Info. Reqts	Filter	Search	Pred-ict	Track	Id. change
8. Quick decisions when circumstances call for them.		-.36	-.28		-.32	-.32
31. [Does not] insist on precision in trivial matters.					-.30	
53. Knows policy or doctrine.		-.33	-.30		-.33	-.33
55. [Does not] lack sufficient technical competence.			-.30	-.30		
67. Persuasive.			-.28			-.31
69. Provides coordination for subordinate organizations ...		-.37	-.30			-.31
73. Sees the pattern in seemingly unrelated problems.		-.31	-.31			
78. Stays composed when under personal attacks by others.	-.34			-.31		-.32
90. Understands an issue before making a decision.		-.36	-.33			-.31

The negative correlations indicate disagreement between self-perception of how good one is at problem-solving processes and their performance as rated by peers.

Only one of the items rated by peers correlated significantly with the performance criterion. The item was #62, "Moves quickly to confront problem subordinates." and the correlation was -.31 ($p<.05$).

Besides this item, five more individual items rated by peers had significant negative correlations with CID rankings (see Table 10).

Table 10.
Azimuth items rated by peers correlating with CID (* < .05, ** < .01)

Azimuth Item	Correlation with CID
12. [Does not] criticize others in front of others.	-.30 *
14. Emphasizes subordinates strengths.	-.29 *
29. His or her plans [do not] need frequent revision.	-.32 *
40. Is [not] impressed with his or her own rank and status.	-.28 *
65. [Does not] often lose his or her temper.	-.44 **

The peer and self-rated elements were regressed on the performance criterion. Stepwise multiple regression resulted in a low proportion of shared variance (r^2= .19, **F** = 2.60, p= .049) with four elements giving the best prediction: self-rated planning and organizational skills (weight of 4.21); peer-rated compulsive behavior (weight of 5.98); self-rated and peer-rated political skills (negative weights of 9.37 and 13.27, respectively). The pattern of correlations and multiple regressions of Azimuth elements and items showed no strong relationships to Critical Information discernment.

Azimuth Correlations with Conceptual Capacity Level. Three of the 12 self Azimuth element scores (problem solving skills, knowledge and political skills) correlated significantly with Conceptual Capacity Level. All of the element scores from peer ratings had negative correlations with Conceptual Capacity Level. The six below -.24 were significant (see Table 11)

Table 11. Pearson product-moment correlations between ranking of Conceptual Capacity Level and Azimuth element ratings (sample size = 65).

Azimuth Elements	Self ratings	Peer ratings
Interpersonal focus	.04	-.36*
Team focus	.12	-.42*
Mission focus	.17	-.24
Problem solving skills	.36*	-.25*
Knowledge	.27*	-.23
Planning/organizational skills	.18	-.20
Political skills	.36*	-.20
Ethics	.08	-.25*
Communication/influence	.13	-.32*
Social maturity	.07	-.14
Self-centeredness	-.03	-.23
Compulsive behavior	.13	-.30*

Correlations between the element scores from self and the Openness and Cognitive Complexity (CC) subtests of the Biodata instrument followed similar patterns as Conceptual Capacity Level (see Table 12 & 13). All but Ethics and Compulsiveness were significantly correlated with the Openness factor. The elements of Mission Focus, Political Skills, and Communication were all correlated with the Cognitive Complexity factor. Correlations between the element scores from peers and the Openness and Cognitive Complexity factors were not significant, but tended to go in a negative direction.

Table 12. Pearson product-moment correlations between ranking of Biodata's Openness and Azimuth element ratings (sample size = 67).

Azimuth Elements	Self ratings	Peers' ratings
Interpersonal focus	.34*	-.17
Team focus	.38*	-.23
Mission focus	.45*	-.16
Problem solving skills	.48*	-.12
Knowledge	.44*	-.09
Planning/organizational skills	.50*	-.03
Political skills	.57*	-.02
Ethics	.18	-.14
Communication/influence	.42*	-.18
Social maturity	.35*	-.02
Self-centeredness	.25*	-.10
Compulsive behavior	.20	-.12

Thirty-seven of the peer-rated items correlated significantly negatively with Conceptual Capacity Level. Forty-eight of the self-rated items correlated positively with Conceptual Capacity Level. Only two were the same item between the 37 "peer" items and 48 "self" items. These two were item #67, *"Persuasive."* and item #69, *"Provides the coordination for subordinate organizations to accomplish interrelated tasks."* The self-rated items both correlated with Conceptual Capacity Level at .28. The `peer' rated items correlated negatively at -.35 and -.29, respectively.

Azimuth Supplemental. None of the self-ratings (see Table 14) or peer-ratings (see Table 15) for the six supplemental items on information discernment behaviors correlated with the same items rated by observers. Also there were no significant correlations on these six items between the students' self-ratings and the ratings by peers (Table 16). The ratings of Critical Information discernment behaviors by observers, student peers, and self did not correlate with each other.

Table 13. Pearson product-moment correlations between ranking of Biodata's Cognitive Complexity and Azimuth element ratings (sample size = 65).

Azimuth Elements	Self ratings	Peers' ratings
Interpersonal focus	.14	-.11
Team focus	.10	-.17
Mission focus	.25*	-.09
Problem solving skills	.20	-.06
Knowledge	.22	-.10
Planning/organizational skills	.23	-.07
Political skills	.44*	-.05
Ethics	.06	-.19
Communication/influence	.26*	-.14
Social maturity	.16	-.05
Self-centeredness	.19	-.03
Compulsive behavior	.04	-.12

Table 14. Comparison of self-ratings and observer ratings on information discernment behaviors.

		Self ratings of performance behaviors					
		CCIR	Filtering	Search	Integration	Prediction	Tracking
Observer ratings of performance	CCIR	-.05					
	Filtering		-.03				
	Search			-.10			
	Integration				-.15		
	Prediction					-.15	
	Tracking						-.09

Table 15. Comparison of peer ratings and observer ratings on information discernment behaviors.

		Peer ratings of performance behaviors					
		CCIR	Filtering	Search	Integration	Prediction	Tracking
Observer ratings of performance	CCIR	.00					
	Filtering		.06				
	Search			.03			
	Integration				-.20		
	Prediction					-.05	
	Tracking						.01

Table 16. Comparison of Azimuth self ratings and peer ratings on information discernment behaviors.

		Self ratings of performance behaviors					
		CCIR	Filtering	Search	Integration	Prediction	Tracking
Peer ratings of performance	CCIR	-.06					
	Filtering		-.17				
	Search			-.22			
	Integration				-.17		
	Prediction					-.11	
	Tracking						-.06

Three of the supplemental items had interesting correlations with performance or quality ratings. One item was on the generalizability of the Azimuth ratings to behavior in their next leadership assignment. Self ratings on generalizability of performance had a positive correlation with performance ($r_{cr,genz} = .34$), however, their rating of their own performance did not correlate with performance measured by observers ($r_{cr,qazs4} = -.12$).

Self ratings on another item (keeps alert for missing, unusual or unexpected information) had a negative correlation with the integration quality rating ($r_{q4,alert} = -.36$), while it had a positive correlation with how well they felt they performed ($r_{qazs4,alert} = .40$). Personnel performing better did not report keeping alert for missing or unexpected information as much as poor performers. Perhaps better performers felt that they already knew what they needed to know while lower performers tried to rely on information that they hoped would become available. This also relates to the low Openness scores for better performers. Perhaps they were more proactive to integrate whatever information was already available and tended to wait less for information to resolve uncertainties.

Ratings by peers on whether the individual was "under time pressure throughout PW96" correlated negatively with all of the quality ratings (from $r_{q2,AZ115} = -.29$ to $r_{q4,AZ115} = -.45$). When peers thought an individual was under time pressure, that individual did not perform well. When individuals weren't seen as under time pressure, those individuals performed better. The appearance of being pressured is probably an

indication that the individual does not have the job under control. The peers' rating of time pressure on an individual agreed better (negative prediction) with performance of that individual than ratings of the quality of integration.

Combining Measures: Partial Correlations

Source of observations. The patterns of correlation showed good agreement for measures rated by the same individuals, but null to negative relationships among ratings by self, peers, and observers. The Conceptual Capacity Level measure relies primarily on self-reports and correlated strongly with the self-report version of Azimuth and the self-report Biodata questionnaire, even on dissimilar items. The scores from the same elements of the Azimuth self-report and peer rater versions did not correlate with one another. There were negative correlations between self-rated political skills and seven peer-rated elements (see Table 17). Similarly, there were hardly any significant correlations between measures from observers and the self-report measures (from either Azimuth or Biodata) or the peer measures from Azimuth.

Table 17.
Pearson product-moment correlations between Peer and Self Azimuth elements (sample size = 66, significant at .05 if <-.24 or >.24).

Peer Rated Elements	Self Rated Elements											
	1	2	3	4	5	6	7	8	9	10	11	12
1 Interpersonal focus	.05	-.11	-.03	-.17	-.07	-.17	-.26	-.06	-.05	-.02	.06	.12
2 Team focus	-.09	-.20	-.14	-.24	-.10	-.16	-.30	.00	-.15	-.07	.03	.01
3 Mission focus	-.09	-.22	-.16	-.19	-.06	-.18	-.25	-.03	-.16	-.12	.00	.09
4 Problem solving	-.11	-.18	-.12	-.19	-.11	-.14	-.27	-.09	-.18	-.16	-.07	-.03
5 Knowledge	-.07	-.14	-.07	-.14	-.10	-.10	-.25	-.13	-.12	-.11	-.09	.00
6 Planning/org skills	-.05	-.14	-.04	-.11	-.04	-.07	-.16	-.04	-.12	-.12	-.03	.08
7 Political skills	.03	-.04	.04	-.05	.08	-.05	-.06	.07	-.05	-.01	.10	.08
8 Ethics	.05	-.15	-.08	-.14	-.14	-.19	-.32	-.04	-.09	-.02	.06	.09
9 Communic/influence	.05	-.15	-.08	-.14	-.14	-.19	-.32	-.04	-.09	-.02	.06	.09
10 Social maturity	.01	-.11	-.06	-.05	-.01	-.10	-.20	-.01	-.01	.05	.08	.12
11 Self-centeredness	.19	.00	.01	-.04	-.03	-.05	-.15	.05	.03	.15	.21	.21
12 Compulsive	.14	-.01	-.03	-.18	-.19	-.11	-.15	.02	-.02	.13	.16	.10

On the six Critical Information discernment items, there were no same-item correlations between observers and the self scores on Azimuth, no same-item correlations between observers and peer scores on Azimuth, and no same-item correlations between the self and peer Azimuth scores. It was anticipated that there would be more agreement among the different sources of data than there was. This raises the question of whether the different raters interpreted the items differently or whether the different groups of raters had different patterns of judgment about the behaviors being rated.

Multiple Regressions

Since there was no apparent relationship between the MCPA's Conceptual Capacity Level and the performance criterion of Critical Information discernment, additional variables were explored for determining what affected performance. Several multiple regressions were computed to screen variables and to retest the relationships found with the correlational analysis. (Note that multiple regressions with a small number of cases are not generally stable and are presented here only for exploratory purposes.)

Variables within seven different constructs (see Appendix B) were regressed separately against the performance criterion. The constructs included cognitive complexity, task performance, personality, leadership, knowledge, problem solving style, and situational characteristics. Stepwise regressions (SAS, 1988) were considered until a maximum r^2 was reached, a maximum number of specified variables was included, or the ratio of variance to the number of predictors approached one (specifically a ratio of Mallow's Cp to the number of variables).

Cognitive complexity. The use of cognitive complexity variables by themselves to predict performance was extremely low with only six percent of the variance explained. The Biodata Cognitive Complexity scale was the major source of variance (see Table 18).

Table 18.
Multiple regression of cognitive prediction variables on CID rankings

Cognitive Prediction r^2= .06, $F_{1,46}$= 2.99	Weight
Biodata	
Cognitive complexity	-3.61
CPA (phrases)	
Conceptual Capacity Level	did not enter
Azimuth (peer ratings)	
Azimuth problem solving	did not enter
Azimuth planning & organizational	did not enter

Participants' performance. A number of measures of performance came from the participants themselves in the form of both self ratings and ratings by peers. The source of the measures came from the Azimuth questionnaire for items that paralleled six of the Critical Information discernment behaviors. The proportion of variance explained by five self ratings and three peer ratings was fairly low at .17 (see Table 19). Proactive search for information contributed positively to the relationship, and tracking minor events contributed negatively.

Table 19.
Multiple regression of participants' ratings of performance on CID rankings

Participants' rating of performance r^2= .17, $F_{8,36}$= .95	Weight
Azimuth (Self ratings)	
CCIR	-2.98
Filtering	4.06
Search	4.65
Integration	-4.01
Prediction	did not enter
Tracking minor events	-4.66
Azimuth (Peer ratings)	
CCIR	did not enter
Filtering	did not enter
Search	2.47
Integration	did not enter
Prediction	1.39
Tracking minor events	-4.97

Personality. Several personality variables were used to examine the relationship with performance. Again the proportion of shared variance was low at .15 (see Table 20). Traits corresponding positively were dominance, need for approval and peer ratings indicating that they did not exhibit compulsive behaviors. Negative contributors were peer ratings of social maturity and self ratings of self-centeredness and compulsive behavior (the negative direction indicating that self perception of high self-centeredness and high compulsiveness relate to high performance).

Table 20.
Multiple regression of personality variables on CID rankings

Personality r^2= .15, $F_{6,41}$= 1.24	Weight
Biodata	
Need for achievement	did not enter
Dominance	2.10
Need for approval	1.33
Azimuth (Self)	
Social maturity	did not enter
Self-centeredness	-2.93
Compulsive behavior	-1.55
Azimuth (Peers)	
Social maturity	-4.65
Self-centeredness	did not enter
Compulsive behavior	5.47

Leadership. Two combinations of leadership variables are presented (see Table 21). The single variable of treating others as objects explained a significant proportion of the variance, but there was a relatively low proportion explained (.15). Extending the regression to a total of four independent variables explained a .36 proportion of the variance. Self ratings of peer leadership and political skills related negatively to performance, while self ratings of how one treats others and generalizability of performance related positively to performance.

Table 21.
Multiple regression of leadership variables on CID rankings

Leadership	Weight - 1st equation	Weight - optimized equation
Biodata		
Peer leadership	did not enter	-2.40
Treats others as objects	5.73	5.19
Azimuth (Self)		
Supervisory- interpersonal	did not enter	did not enter
Supervisory-mission focus	did not enter	did not enter
Political skills	did not enter	-3.60
Ethics	did not enter	did not enter
Communication	did not enter	did not enter
Supervisory-team	did not enter	did not enter
Azimuth (Supplemental)		
Performance Applies to next assignment	did not enter	5.73
Predicted Commander effectiveness	did not enter	did not enter
	r^2= .15, $F_{1,43}$= 7.45, p=.0092	r^2= .36, $F_{4,44}$=5.72, p=.0010

Knowledge. Variables relating to knowledge and experience were not very extensive in this study. Only two variables from the Azimuth element of tactical and technical knowledge were regressed against performance with a minimal proportion of variance in common (.02) (see Table 22).

Table 22.
Multiple regression of knowledge variables on CID rankings

Knowledge r^2= .02, $F_{1,47}$= .98	Weight
Azimuth (Self)	
Tactical/technical	-2.10
Azimuth (Peers)	
Tactical/technical	did not enter

Style. The style of processing or problem solving was characterized by the Biodata Openness scale and several individual items from Azimuth. Almost 30 percent of the performance variance was contributed negatively by `Openness' and 'keeping alert for unusual information' and positively by

`adequate analysis' and `option dominance approach' (see Table 23). Most individuals (60 percent) reported a procedural approach, while 20 percent reported a dominance approach.

Table 23.
Multiple regression of style variables on CID rankings

Style r^2= .29, $F_{4,43}$= 4.48, p=.0041	Weight
Biodata	
Openness	-4.85
Azimuth (Supplemental, Self)	
Analytic	6.69
Considers own errors	did not enter
Uncertainty-reasons	did not enter
Alert for unusual info	-5.20
Quick, part solution	did not enter
Option dominance	3.37

Situation. Situational variables explained about a quarter of the shared variance with performance (see Table 24). The rank of position was the largest contributor while intelligence jobs and perceptions of time pressure contributed negatively to the relationship.

Table 24.
Multiple regression of situational variables on CID rankings

Situation r^2= .26, $F_{3,46}$= 5.28, p=.0033	Weight
Questionnaire	
Command or staff position	did not enter
Echelon	did not enter
Operations job	did not enter
Intelligence job	-2.13
Rank of position	7.11
Azimuth (Supplemental,)	
Time pressured in PW	-3.39

Combined constructs. The variables contributing most to the single construct multiple regressions of leadership, style and situation (Tables 18-24) were combined. This resulted in seven predictor variables with a shared variance of .51 (see Table 25).

Table 25.
Multiple regression of combined constructs on CID rankings

Combined constructs r^2= .51, $F_{7,39}$= 5.87, p=.0001	Weight
Leadership	
Treats others as objects	4.03
Performance Applies to next assignment	4.02
Style	
Openness	-4.23
Analytic	4.27
Alert for unusual information	-4.52
Situational	
Rank of position	3.74
Time pressured in PW	-1.97

Interview results

Several students were interviewed to find out if there were any additional insights that could be derived about the findings. Students were selected for interviews if their scores on information discernment and Conceptual Capacity Level were either high on both measures, low on both, or high and low. Three of the selected students scored above average to high on both measures and two scored low on both. Two scored low on performance but were rated among the highest on Conceptual Capacity Level. Two more students were rated high on performance and rated low on Conceptual Capacity Level. One additional student was included because he ranked best on performance and a mid position on Conceptual Capacity Level. These students were asked about their educational background, unique assignments, outside interests, influential people in their lives, most notable achievement, and what job or position has been beyond their comfort zone.

More similarities were discovered among these eight students than differences. Six of the eight had a father who had been in the military. Six of the students listed participating in sports as an interest, as well as reading.

Differences that existed did not clearly delineate differences within or between performance and Conceptual Capacity Levels. Those ranking second through fourth best in performance in this group listed a previous Commander as having a substantial influence in their career. The type of influence dealt primarily with observing competence, attitude, problem solving style, and general excellence. The five lower performers of those interviewed were commissioned through ROTC, while the top three came from the US Military Academy or Officer Candidate School.

The three students ranking lowest on Conceptual Capacity Level (scoring 7.5, 8, and 9) had bachelor degrees in the sciences (political science, psychology, and biology), while the rest--except for the highest cognitive ranking individual--had majors in music, foreign language, personnel management, and history. The individual ranking highest among the eight on Conceptual Capacity Level was the only one of the eight who peers rated very low on projected effectiveness as a Battalion commander. The next three to this individual on Conceptual Capacity Level were the only ones to list a notable achievement. The types of achievement were very different, dealing with being a company commander in Desert Storm, coaching subordinates in a poor command climate, and convincing others to do things his way.

Observations of the Combat Information Center (CIC)

Although the CIC was not a specific factor in the design of this case study, its use helped to highlight the importance of Critical Information discernment. Its operation was observed and several observations and conclusions are offered.

The Combat Information Center was designed to produce "a single, synthesized picture of friendly and enemy forces, and the battlespace environment." This seemed like an ideal location to observe the quality of Critical Information discernment. As it turned out the CIC staff did not do much Critical Information discernment.

During the first few days of the exercise, the CIC experienced technical problems with the computers. By the third day the system was mostly working. Even with the system operational, the CIC staff concerned themselves with fairly mechanical tasks of relaying information, rather than analyzing, interpreting, and integrating the meaning of it (as intended in the CIC concept, EER, 1996). The CIC staff were more concerned with receiving information and producing and sending overlays, than focusing on the overall tactical picture, considering possible outcomes, or clarifying the picture among battlefield operating systems. They were interested in the accuracy of the information they received and at what echelon to aggregate it. Their measure of success appeared to be gauged by the number of combined overlays they were capable of preparing and the speed with which they could prepare them.

Observers' ratings of their performance supported these observations. The CIC staff scored (4.5) significantly lower than the rest of the Mobile Strike Force (6.6) on the quality of integration (t= 2.76, p<.01). Comments overheard from the CIC staff also supported the observation. They were heard to say that they did not have the big picture of the battle and that they were isolated from the decision makers. Therefore they were not sure what was relevant. The MSF Commander was heard at one point to say that the CIC product was not giving him anything that he could use.

The CIC did not function as well as intended. This could be attributed to a number of factors; perhaps the most overlooked was advance considerations to what functions the personnel were to serve. The design of the CIC tended to restrict the personnel to operators serving in the role of an information conduit. Their role as analysts was not very strong; and how they were to fuse information from their respective battlefield operating systems was not clearly specified. It is not clear whether the way the CIC operated was what was intended or the jobs just evolved this way due to the lack of integration of people into the concept.

The concept for the CIC should be reviewed carefully by those organizations responsible for developing it. If there is enough merit to continue to test it, explicit decisions should be made about the role

people are to serve. There should be some way devised to help the CIC staff maintain situation awareness and to understand or anticipate what information will be relevant to the decision makers.

The officer-in-charge of the CIC and all other staff should be trained to assume responsibility for understanding the battlefield from the information they are handling. Additional procedures should be implemented for transmitting high priority alert information outside the normal cycles of producing the relevant common picture. If the staff is not more responsible for understanding and using the information they are handling, the products from the CIC will be of limited value.

Conclusions

The lack of confirmation of a relationship between conceptual capacity level and critical information discernment was puzzling. Equally puzzling was the negative correlation between the related Openness scale from the Biodata instrument and critical information discernment performance. A discussion of possible explanations for the null findings follows. A number of alternatives were considered and tested where data were available.

Exercise Complexity

The null relationship between Conceptual Capacity Level and Critical Information discernment may have occurred because of particular conditions of the exercise. The exercise may have not been challenging enough, therefore, students were not fully engaged in completing the tasks. Cognitive complexity requirements are supposed to increase at higher leadership positions in an organization. Since a considerable portion of the exercise was played at division level, one contention was that the requirements for conceptual abilities were not as prominent as they would be at higher echelons. Problems that the students faced may have been routine, where experience dominated and complex problem solving behaviors were not evoked. Differences among the complexities of different jobs could have concealed a direct relationship between the predictor and the criterion.

However, counter to this argument, there were several indications that the exercise requirements were challenging. Most of the students (80%) thought that difficulty was medium or higher. Students' ratings of experienced difficulty moderately correlated with the criterion but did not change the correlation between the criterion and the predictor when it was partialled out. Twenty-two percent thought the change from expected to experienced difficulty was positive and one third thought it was undesirable. Students rated similarity of their previous experience to what they did in PW96. Forty-one students rated similarity an average of 4.1, about the midpoint of similarity. Their similarity rating did not correlate with either the performance or Conceptual Capacity Level measure, and partialling out (or controlling for experience) did not increase the correlation between Conceptual Capacity Level and Critical Information discernment.

Some jobs may have been more complex than others, but the students' response to the job demands was probably a more prominent factor. The variable of rank of the job was considered. It was found to correlate with the performance criterion ($r_{cr,pos}$=.35, p= .01) but when partialled out, did not significantly improve the correlation between the criterion and the predictor.

Most of the students had not performed staff and command functions at division or corps echelons. Even if they were using their educational experience or experience from lower echelons, it seems inappropriate to say the problems they faced were routine. Further consideration of the observers' explanations of Critical Information discernment--both positive and negative--indicated that situations and responses were not routine. All of these data show no indication that the jobs were not challenging enough, too routine, or too simple.

Measuring Conceptual Capacity Level

The most significant concern we had with the Conceptual Capacity Level variable was the lack of difference between this sample of CGSOC students who were mostly majors and an earlier sample of Army

War College (AWC) students who were lieutenant colonels (Lewis, 1993). Stratified Systems Theory suggests that the distribution of Conceptual Capacity Level should be different depending on the level of management. As the level of the organization increases, there should be a higher proportion of higher Conceptual Capacity Levels than at lower levels of the organization. There was no statistical difference found between the two distributions. Several possible explanations exist.

It's possible that the CGSOC sample is disproportionately high, or the AWC sample was disproportionately low, although we found no specific evidence to support these claims. One possible explanation is predicated on the closeness of the average ages in each study. The average age of the PW96 subjects was 37 and the ICAF sample was 42. These ages are close enough on the maturation curves in the CPA protocol so as to not significantly affect current capacity level. So what could have caused this lack of difference? Our researchers are divided on this question Another possibility is the PW96 subjects exhibited a disproportionately higher level of current conceptual capacity (relative to their experience) because the Army does not advance people on the basis of conceptual capacity. (McGee, Jacobs, Kilcullen, Barber, 1996)

In the AWC sample, rater-rater reliability for 52 interviews was .81. (However, one rater's scoring was based on direct interviews, while the other rater used only written records from the CPA methods.) Two AWC instructors rated 32 of the 52 interviewees on their potential for strategic thinking and as a general officer. Reliability estimates were .57 and .34, respectively on these two measures between the instructors. Construct validity was computed as the correlation between the sum of the instructors' ratings of potential and the Conceptual Capacity Level scores. Construct validity was .42 for strategic thinking potential and .46 for general officer potential. Although these validity levels are somewhat supportive, they are not overwhelming proof that Conceptual Capacity Level is a dependable predictor at present.

Based on work by Lewis (1993), some of the phrases were modified, but no updates to the psychometric qualities have been made. The modified phrases measures for this study considered objective scoring items like length (the number of lines of written explanation of chosen phrases) and time (the average time to select phrases). Coren and Suedfeld (1990) report that attempts to use objective measures (like the total number of words written, sentence length, and readability indices) in a different measure of complexity, the Paragraph Completion Test, cannot replace scoring of the semantic content. Semantic content was clinically judged to determine the Conceptual Capacity Level in this study.

The MCPA phrases involve self-report preferences for ways of working but without situational or domain-specific norms. People do not commonly discuss ways of thinking and might not have interpreted the phrases as expected. This is not something that would be apparent in any of the validity checking that has been done to date.

> People generally do not think about the way they process information and consequently find it difficult to respond meaningfully to questions about their own capacity to differentiate and/or to integrate. In response to direct questions about their information-processing style, individuals tend to respond in a socially desirable fashion, simply because it sounds good to be cognitively complex. In addition, less-complex persons do not realize that they actually employ a single (or very few) dimensions when they process information . . . because they tend to assign diverse labels to dimensional characteristics that are, in fact, highly correlated. (p. 148, Streufert & Swezey, 1986).

We do not have a precise language for how we think, so it is possible there is wide-ranging interpretation of the MCPA phrases.

The Symbols portion of the CPA method has an advantage over the Phrases because it requires the individual to demonstrate an ability. But the task is a rule induction task. This task would seem to be only partially related to the conceptual capacity construct. In the task the individual must determine the rule that the experimenter has in mind. Trying to determine and conform to someone else's rule does not seem to be in total correspondence with the highest levels of conceptual capacity, where new relationships are recognized and created.

Additional examination of the psychometric parameters of the Conceptual Capacity variable seems to be in order. Additionally, other measurement methods should be identified (or developed) and tried. There should be more emphasis on requiring the individual to demonstrate abilities as opposed to attempt to describe processes about which he or she may not be familiar.

Measuring Critical Information Discernment

Although data on construct validity of measurement of Critical Information discernment was not available, measurement was focused on specific behaviors. Discernment performance was examined and rated by knowledgeable observers. Mostly at issue was the breadth of behavior that the observers has to consider when rating a Discernment item. To the extent there was error in the measurement, the observers probably erred on the side of generality, including behaviors beyond discernment. If anything, a broader set of behaviors should be expected to be a more reliable indication of battle command performance, not less so.

There are several problems in measuring cognitive performance by observation, as we were constrained to do in this study. These difficulties were anticipated and means were taken to lessen them. Different Critical Information discernment behaviors were identified. Behaviors that represented different interpretations of information discernment were included, starting with the relatively straightforward process of attending to and managing formal information requirements established by the commander. Behaviors also were considered that were short of decisions, including when insightful use of information might occur in battle command tasks. Critical insights are characterized by using information to make predictions, keeping alert for possible dangers that have been brought to mind by some information, and the identification or anticipation of the need to make changes in planned schedules, assets, boundaries, or missions.

Another possible limitation was the differences from observer to observer in how a student was rated. Differences were lessened by the observer training and by having members of the research team observe both the students and the observers in the performance of their duties. The narrative explanation on the score sheet consistently provided the most insight into a student's Critical Information discernment performance.

Raters indicated both the frequency and quality of the behaviors to distinguish between the occurrence of a behavior and its quality. The rating process was tested in a prior simulation exercise and modifications made. Observers were used that were familiar with battle command tasks. Since the tasks have not been measured in this way before, normative or doctrinal standards did not exist for comparison. The score sheet fulfilled its intended purpose. It enabled researchers to discriminate among students' Critical Information discernment behaviors, and did not impose an excessive workload on the observers.

Increased attention should be given to the training of observers in future studies. Educating them of the purpose and value of the study is the first step. Training could be improved by having the observers rate examples of the behaviors, have them distinguish among behaviors, and then discuss ratings from different observers. This process was approximated with the trial application in the MSF simulation exercise, but only about a fourth of the observers were available to participate. Twenty-two of the thirty observers went through a one hour training orientation prior to the exercise. The remaining eight received individual training once the exercise began. More deliberate training would undoubtedly help give observers more precise ideas about what to look for and what to record.

Individual and Group Behaviors

The Critical Information discernment behaviors that were observed were assumed to be attributable to the individual being rated. However, it was recognized that an observer might only hear what the individual is repeating from what others have told them. An individual in a command post is not working in isolation, but is processing information and having ideas triggered from what others say. The dynamic environment introduced other factors that were not assessed in this case study. Factors such as group cohesion and the lack of an actual rank hierarchy limited the interpretation of these findings as generalizable to tactical/troop units. Future experiments could examine individual ability to discern critical information, perhaps by assessing a controlled task in conjunction with a tactics class or inserting and tracking probes in Combat Training Center rotations and Division and Corps Warfighter exercises.

Additional Measures

There was little information obtained indicating knowledge, experience, or motivation. These should be strong individual difference variables that can help account for many of the differences in performance.

Experience. A plausible hypothesis is that experience or knowledge had a considerable influence on performance. Differences in experience could have overshadowed other differences or effects of cognitive complexity or others. Even with Azimuth ratings on tactical and technical knowledge and the additional survey question on similarity, there was relatively little information obtained on what each student knew and what kind of tactical and operational experience he or she had.

Motivation. If we assume motivation is higher when the level of challenge is roughly equal to the level of ability (conceptual capacity), then lower motivation would be in evidence for high capability and low capability people if the tasks are construed as moderately difficult. The high capability people disengage out of boredom, and the low capability people disengage because they can't keep up. We attempted to account for these two categories in several ways. At first we partialled out estimates of motivation on 25 students. There was no significant improvement in the magnitude of the correlation between performance and conceptual capacity level ($r_{CID,CL.mot} = .07$). We also examined the partial correlation between performance and Conceptual Capacity Level when difficulty was controlled for ($r_{CID,CL.diff} = -.04$, $p = .85$). Motivation and experience should be considered to a greater extent in future studies in this area.

Recommendations

- Retest the hypothesis with other objective measures of conceptual capacity. The existing CPA or MCPA could be used again so it can be compared against other methods. Consider augmenting the CPA/MCPA with additional tools that measure other aspects of conceptual capacity. In addition to self-report or concept formation measures, measures should be identified or developed that address the abilities to understand complex and dynamic relationships and frame solutions for these problems.

- Additional study is needed to understand the relationship between conceptual capacity and individual performance. The hypothesis should be retested with a common task that all individuals do by themselves. The task should be one where good measures on performance of information discernment and related battlefield visualization skills can be taken. Additionally, we should consider measuring performance in mature organizations. If proper controls can be developed, an experiment conducted in a tactical/troop unit would probably yield the most useful information.

- The measurement of Critical Information discernment should be developed further, especially in the definition of desirable and undesirable behaviors and descriptive anchors used in measurement. Develop training techniques which provide observers the required expertise for accurately distinguishing among behaviors. Additional ways of measuring the human dimension of battlefield visualization and decision making should also be considered.

- Future studies should expand the hypothesis to consider additional skills related to a leader's conceptual competence. Critical Information discernment is only one element of battlefield visualization. It tends to be more of a convergent, closed-ended task rather than a divergent one, where creative problem finding and novel solutions are important.

- A systems approach could be followed to better consider the whole person and environmental influences on them. Motivation and experience are two areas recommended for better measurement.

Summary

The findings in this study underline the complexity involved in understanding the cognitive aspects of human behavior and the intricate relationships among the factors. The findings emphasize the need for increased effort to understand and define the conceptual skills that are desired in Army leaders. Measuring conceptual capacity in a way that requires individuals to demonstrate their ability provides a possible focus for future research and training development efforts. Follow-up studies are essential to address these additional aspects of the human dimension of Battlefield Visualization and to assist in the design of strategies which address the development of conceptual competencies. The best possible outcome from this study would be that it energizes multiple efforts for improved leader development programs.

References

Bruner, J. S. (1966). *Studies in cognitive growth.* New York: Wiley.

Coren, S., & Suedfeld, P. (1990). A power test of conceptual complexity: Textual correlates. *Journal of Applied Social Psychology, 20,* 357-367.

EER Systems, Inc. (1996). *Combat Information Center (CIC) concept.* Training Systems Division, Leavenworth, KS.

Fredericksen, N. (1986). Toward a broader conception of human intelligence. In Sternberg, R. J. & Wagner, R. K. (Eds.), *Practical Intelligence.* NY: Cambridge Univ. Press.

Headquarters, Department of the Army. (1987, June). *Executive leadership* (DA PAM 600-80). Washington, DC: Author.

Headquarters, Department of the Army. (1990, July). *Military leadership* (FM 22-100). Washington, DC: Author.

Holyoak, K. J., & Nisbett, R. E. (1988). Induction. In R. J. Sternberg & E. E. Smith (Eds.), *The psychology of human thought.* NY: Cambridge Univ. Press.

Hooijberg, R., & Quinn, R. E. (1992). Behavioral complexity and the development of effective managers. In R. L. Phillips and J. G. Hunt (Eds.), *Strategic management: A mutiorganizational-level perspective.* New York: Quorum.

Jacobs, T. O., & Jacques, E. (1987). Leadership in complex systems. In J. Zeidner (Ed.), *Human productivity enhancement,* Vol. 2. New York: Praeger.

Jacques, E. (1976). *A general theory of bureaucracy.* Exeter, NH: Hieinemann.

Jacques, E. (1989). *Requisite organization.* Arlington, VA: Cason Hall.

Jacques, E., & Clement, S. D. (1991). *Executive leadership: A practical guide to managing complexity.* Arlington, VA: Cason Hall.

Klein, G. A., Orasanu, J., Calderwood, R., & Zsambok, C. E. (1993). *Decision making in action: Models and methods.* Norwood, NJ: Ablex Publishing Corporation.

Kluever, E. K., Lynch, W. L., Matthies, M. T., Owens, T. L., & Spears, J. A. (1992). Striking a balance in leader development: A case for conceptual competence. National Security Program Discussion Paper Series 92-02. Harvard University.

Kolb, D. A. (1984). *Experiential learning. Experience as the source of learning and development.* Englewood Cliffs, NJ: Prentice-Hall.

Lewis, P. (1993). *Career Path Appreciation (CPA) data reduction and analysis* (ARI Technical Report 983). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A273 225)

McDaniel, E., & Lawrence, C. (1990). *Levels of cognitive complexity: An approach to the measurement of thinking.* New York: Sprenger-Verlag.

McGee, M. L., Jacobs, T. O., Kilcullen, R. N., & Barber, H. (1996). *Developing leaders for the new Army.* Army Leadership Symposium, Chicago, IL, March 1996.

Michel, R. R., & Riedel, S. L. (1988). *Effects of expertise and cognitive style on information use in tactical decision making* (ARI Technical Report 806). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A203 462)

Payne, J. W., Bettman, J. R., & Johnson, E. J. (1993). *The adaptive decision maker.* New York: Cambridge University Press.

Phillips, R. L., & Hunt, J. G. (Eds.). (1992). *Strategic leadership: A multi-organizational-level perspective.* Westport, CT: Quorum Books.

SAS Institute, Inc. (1988). *SAS/STAT™ user's guide, Release 6.03 edition.* Cary, NC: Author.

Soloway, E., Adelson, B., & Ehrlich, K. (1988). Knowledge and processes in the comprehension of computer programs. In M. T. H. Chi, R. Glaser, and M. J. Farr (Eds.), *The nature of expertise.* Hillsdale, NJ: Lawrence Erlbaum.

Stamp, G. (1986). Some observations on the career paths of women. *Journal of Applied Behavioral Science, 22*(4), 385-396.

Stamp, G. (1988). *Longitudinal research into methods of assessing managerial potential.* (Technical Report DAJA45-86-C-0009). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Streufert, S., & Swezey, R. W. (1986). *Complexity, managers, and organizations.* Orlando, FL: Academic Press.

Streufert, S., & Streufert, S. C. (1978). *Behavior in the complex environment.* Washington, DC: V. H. Winston.

Appendix A

Critical Information Discernment

Score Sheet

1. *Observer* _____ **Critical Information Observation Sheet**

2. *Student* _____ 3. *Date* _____

General Activities	*Rating*	*Use of Information*	*Rating*	*Immediate Actions/Insights**	*Eventual Results of Actions/Insights**
4. Management of and attention to formal CCIRs.	a. b.	8. Specific predictions of battlefield situations.	a. b.	c.	d.
5. Filtered information.	a. b.				
6. Information sought out. (proactive or passive?)	a. b.	9. Kept track of minor--but potentially critical situations--as they developed.	a. b.	c.	d.
7. Integrated information to produce critical insights. c. Explain.*	a. b.				
		10. Identified or anticipated major changes in enemy or friendly inten-tions, schedules, resources & boundaries.	a. b.	c.	d.

11. Remarks about extenuating circumstances. Did student perform above, at or below potential? Was the student constrained by the position or by command relationship? Did the realism or quality of information change? How serious of a threat was the OPFOR?

**Descriptions.* Provide specific information about the situation. What was good or bad about the information discernment? How good or poor were the student's actions?

Ratings. Each activity should be rated on frequency & quality. Rate frequency according to whether the student displayed the activity when he or she should have.

a. When required?:
- A - *Always*
- U - *Usually*
- S - *Seldom*
- N - *Never*
- NW - *Never warranted*

Rate the quality of each activity (for 4-10 above) compared to all other Army Majors you have seen.

b. Quality?:
- 10 - *One of the best*
- 9 -
- 8 -
- 7 -
- 6 -
- 5 - *Average*
- 4 -
- 3 -
- 2 -
- 1 -
- 0 - *One of the worst*

Appendix B

Number of Participants

Completing Each Measurement Instrument

Number of Participants Completing Each Measurement Instrument from each CGSOC student group

Measurement	MSF	Student Corps	Total
Modified CPA	39	26	65
Critical Information Discernment	33	17	50
Biodata Survey	40	27	67
Azimuth Survey	41	27	68
Experience follow-up survey	28	17	45
Estimate of motivation	19	6	25
Interview	8	0	8
All study participants	*41*	*27*	*68*

Appendix C

Categories of Measures Used in Prairie Warrior 96

Construct	Measure	Source
Cognitive prediction	mean_CL (average complexity level)	CPA methodology, modified for this study. Self-report and CPS scorer interpretation.
	CC (cognitive complexity)	Biodata scale. Self-report.
	Open	Biodata scale. Self-report.
	EL4 (problem solving skills)	Azimuth element. Self and peer report.
	EL6 (planning & organizational skills)	Azimuth element. Self and peer report.
Critical information discernment	CR_rank (critical information discernment ranking)	Ranking of 50 students on CID performance by researchers based on O/C rating sheets.
	CID (critical information discernment category)	Performance categories of low, medium, medium-high, or high made by researchers based on O/C rating sheets.
Information handling	f1, q1, & r1 (Management & attention to formal CCIR)	CID performance scoresheets completed by O/Cs. f1= frequency. q1=quality. r1=combined frequency & quality.
	f2, q2, r2 (Filtering of information)	CID performance scoresheets completed by O/Cs.
	f3, q3, r3 (Information sought out)	CID performance scoresheets completed by O/Cs.
Use of Information	f5, q5, r5 (Predictions of battlefield situations)	CID performance scoresheets completed by O/Cs.
	f6, q6, r6 (Kept track of minor-but potentially critical situations-as they develop)	CID performance scoresheets completed by O/Cs.
	f7, q7, r7 (Identified or anticipated major changes in enemy or friendly intentions, schedules, resources, and boundaries.)	CID performance scoresheets completed by O/Cs.
	f4, q4, r4 (Integrated information to produce critical insights.)	CID performance scoresheets completed by O/Cs.
	cr1_3	Combination of r1, r2, r3.
	cr457	Combination of r4, r5, r7.
	cr1_7	Combination of r1-r7.
	qaz1-qaz6, qazs1-qazs6	Azimuth supplemental items. Self & peer reports.
Personality	Achieve	Biodata scale. Self-report.
	CPDom2	Biodata scale. Self-report.

	Needapp	Biodata scale. Self-report.
	Object	Biodata scale. Self-report.
	EL10, ELS10 (Social maturity)	Azimuth element. Self and peer report.
	EL11, ELS11 (Self-centeredness)	Azimuth element. Self and peer report.
	EL12, ELS12 (Compulsive behavior)	Azimuth element. Self and peer report.
Situational	Command or staff position	Student assignments.
	Echelon	Student assignments.
	Type of job (command, operations, intelligence, combat service support)	Student assignments.
	Rank of position (CPT to LTG)	Student assignments.
	AZ115 (time pressure in PW)	Azimuth supplemental item. Peer report.
	Similarity	Follow-up question. Self-report.
	Difficultly, expected & experienced.	Follow-up question. Self-report.
Leadership	EL1, ELS1 (Supervision - interpersonal)	Azimuth element. Self and peer report.
	EL2, ELS2 (Supervision - team)	Azimuth element. Self and peer report.
	EL3, ELS3 (Supervision - mission)	Azimuth element. Self and peer report.
	EL7, ELS7 (Political skills)	Azimuth element. Self and peer report.
	EL8, ELS8 (Ethics)	Azimuth element. Self and peer report.
	EL9, ELS9 (Communication, influence)	Azimuth element. Self and peer report.
	Peer leadership	Biodata scale. Self-report.
	Seeing others as objects	Biodata scale. Self-report.
	AZ117 (Bn Commander effectiveness)	Azimuth supplemental item. Peer report.
Knowledge	EL5, ELS5 (Tactical, technical-Knowledge)	Azimuth element. Self and peer report.
	Similar (similarity of this position to your experience)	Follow-up question. Self-report.
Style	Open	Biodata scale. Self-report.

	AZS114 (self rating of quick, partial solutions)	Azimuth supplemental item. Self report.
	AZS99 (analytical)	Azimuth supplemental item. Self report.
	AZS100 (considers own errors)	Azimuth supplemental item. Self report.
	AZS101 (reasons through uncertainty)	Azimuth supplemental item. Self report.
	AZS104 (alert for unusual information)	Azimuth supplemental item. Self report.
	AZS118 (dominant problem solving style)	Azimuth supplemental item. Self report.